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SHALL WE PUT SPECTACLES ON CHILDREN?

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Shall we put spectacles on children, is a question often asked of the family physician by parents, and, from want of proper information, is often answered in the negative. According to the traditions, the need of spectacles is an indication of old age, and so the world interprets it. A better knowledge however, is diffusing itself, first among the medical profession, and from them to the public, that the age is not the only criterion as to the necessity for optical aid. While advancing years may be a factor, it is only one of many causes inducing defective vision.

A typical man is a very different person from man as we find him. In like manner, every day experience teaches us that the human eye varies much from the type of a perfect one, viz., one with which good vision can be comfortably enjoyed for any distance, far or near. The name *emmetropic*, or full measuring, is given to an eye which can focus equally well light coming from a near or a distant object. In its various dimensions, such an eye is the standard of perfection. It must not only be symmetrical in all its parts, but the position of the lens must be such, that light, passing through it from a distant source, will be focused upon the sensitive lining of the inner eye chamber. In other words, the crystalline lens in its passive state must focus accurately on the retina to make perfect images for brain interpretation. In such a well formed eye, the accommodation muscles of the ciliary region can make the lens more convex, so as to adapt it for condensing the light from approaching bodies, and thereby keep the focus always on the retina, regardless of the distance from which the light is reflected. This function of the perfect eye corresponds with an established law of optics, viz., that unless a lens focuses accurately on the recipient surface, the image made by transmitted light must be more or less imperfect.

However perfect the human eye may be, it must grow old with the accumulating years of the individual. This deterioration disturbs sight for near work, and is brought about by hardening of the lens from increasing density and shrinkage of its substance. When this change has taken place, the eye can no longer focus for near small objects, unless aided by a convex lens from without, the well known magnifying spectacle.

The world says that the eyeball flattens with age. The physician knows that the eyeball does not change its shape, except as the effect of disease; but that it is the crystalline lens inside of the

eyeball, which, by condensation and consequent shrinkage, slowly becomes more and more flat as age creeps on. The diminution in convexity of the living lens is a perfectly natural condition, and must take place in every living person as age advances.

The crystalline lens is composed of elongated cells, tubes, or fibres, arranged in layers. The first, formed in the embryo, becomes the nucleus, upon the surface of which new layers are produced, till the lens attains its full growth. Maturity in this special part of the body is attained in childhood, and at a much earlier age than the development of many other portions. It is considered complete at the age of twelve. The peculiar arrangement of its layers and fibres, with layer superimposed upon layer, till they are counted by the hundreds, produces a very elastic mass, in the shape of a bi-convex lens, of very short focus, and therefore of very great magnifying power. This lens, enveloped in its capsule, is kept in its proper place behind the pupil by a suspensory ligament, which, with the lens, forms a complete partition in the eye, separating the vitreous from the aqueous chambers. As the larger periphery of the broad circular ligament is attached to, and is blended with the retina and choroid layers at their anterior termination at the equator of the eyeball, with the smaller circle attached to the enveloping capsule, the lens is very securely suspended. This ligament is called the *zonula of Zinn*. The action of the zonula is to draw the capsule firmly over the front of the lens so as to mash it down, and thereby diminish the convexity of its anterior surface. This flattened condition is recognized as the passive state of the crystalline lens.

A typical eye should have light, coming from a distance, focused by the flattened lens directly upon the retina. The ciliary muscle, when in action, relaxes the compressing ligament, so that the natural elasticity of the lens, responding at once to the relief, becomes more convex, and is therefore, in condition to focus more powerfully light coming from near objects. So very elastic is the laminated lens of young persons, when the ciliary muscle, by its action releases it from pressure, that its excessive convexity enables it to focus light from a very near source. Children with well shaped eyeballs can read print when held three inches from the face. With the natural growth of the individual, the excessive elasticity becomes impaired, so that at the age of twenty years, letters cannot be made out inside of four inches from the eye. At the age of thirty, so much of the elasticity of the lens has been lost that it is incapable of focusing within six inches; and at forty years of age its continued increasing condensation of substance has so restrained its convexity by elasticity, when the whole pressure of the flattening ligament has been removed, that fine letters can only be made out for a few minutes when held at eight inches from the eye. This distance is still equivalent to the comfortable reading of ordinary print at the usual reading distance of twelve inches.

Up to the age of forty no inconvenience has been experienced in a well formed eye from the shrinkage of the lens, only its excessive, and what may truly be considered its superfluous, elasticity has been used up. It is still capable of doing full work. Having now no elasticity to spare, it is working up to its fullest capacity. Unfortunately, there is no arrest in the deterioration at this age of forty, but the condensation still goes on. When a healthy individual, with a perfectly formed eye, exceeds the age of forty-five, the lens will have lost so much of its elasticity that under the full relaxing action of the ciliary muscle and the removal of all flattening pressure, the remaining inherent elasticity cannot keep the lens sufficiently convexed to sustain for any length of time a focus on the retina for light coming from near objects. It is on this account that reading, for fine print, at the usual distance of one foot becomes uncomfortable. Now it is that the wearing of a weak convex spectacle restores the ability to read, because it replaces the deficient convexity of the crystalline lens. As the shrinkage continues from year to year, and more supplementary convexity is needed from without, the magnifying spectacles have to be changed for stronger ones, till very old age is reached. It is therefore the loss of elasticity in the lens, and a lessening of the convexity of its surface, which compels every one who has perfect eyes to use convex spectacles, to aid them in comfortable reading, when they have attained the age of forty-five years. Also, that the compulsory change of spectacles, using stronger magnifying glasses from year to year, as age progresses, represents the progressive condensation, shrinkage, loss of elasticity, and flattening of the crystalline lens. This is a normal condition in the regular changes which belongs to all human eyes.

We have seen that what is called accommodation, or ability to change the focus, is a muscular act, which, by taking off pressure from the front of the lens, permits the inherent elasticity of the lens to give its surface greater convexity, and therefore greater focusing power for clearly seeing small near things. When reading, sewing or writing is indulged in, it is by muscular action, permitting changes in the lens surfaces. While vision consists in the formation of an image on the retina, and transmission of the peculiar irritation induced thereby through the optic nerve to the brain for interpretation, the continued comfortable use of the eyes depends much more upon the action of muscles, than upon the sight nerve. These accommodating muscles are under the control of the will. Their work is identical with that of the various muscles of the body. When these muscles are temporarily enfeebled by diseased conditions of the system at large, they do not lift off sufficiently the flattening band, or they are too weak to keep up the continued action for the relief of lens pressure; hence it is that sick persons, with weakened muscles, cannot read as long, nor with the same comfort, as when well and strong.

Eyes become painful and letters run together for want of prolonged muscular action to sustain the focus power of the lens. When the lens in after years fail to obtain a sufficient convexity to ensure the use of the eye for near work, convex glasses are called into requisition to add to the strength of the crystalline lens. When from feeble muscles the convexity of the lens cannot be sustained, a magnifying spectacle, for temporary use, will enable persons to read, while tonics are being administered to restore permanent strength to the weakened muscular system.

We often find children recently recovered from an attack of measles, scarlet fever, diphtheria, whooping-cough, or from any one of the depressing diseases of childhood, unable to study as they did before the attack. For a little while the eyes seem as strong as ever, but a very few minutes use will cause letters to run together, and the print becomes blurred. They rest the eyes and can see clearly for a short time, when blurring again ensues. This is not a failure of the retina or optic nerve, but of the muscles acting on the lens. A weak magnifying spectacle, by helping the muscles to do their work, will enable weak children to continue their studies, till tonics, daily administered, restore the needful strength to the enfeebled muscles. Many adults, weakened by disease, cannot walk a square without fatigue, yet complain that their eyes will not permit them to read by the hour, not knowing that reading, as well as walking, is a muscular work. Under such a weakened condition, magnifying glasses will do for the eyes what a carriage will do for the body, viz., will rest the muscles while exercise is being taken.

The foregoing explanations show that all good eyes in strong persons need help by the use of magnifying glasses after the age of forty-five has been reached. Also, that even well shaped eyes in young persons require the temporary use of convex glasses, should the muscles of the eye, owing to bodily infirmity, become at any time too weak to accomplish the work assigned them in the animal economy

All of the foregoing statements are based upon typical perfect eyes. Unfortunately, the eyeball, with the many other features, is not always the perfection of symmetry. In nature we find many ill shaped eyes, deviating more or less from the standard needful for perfect vision. If made after the standard, all human eyes ought to be nearly round These are the *emmetropic* or typical eyes, which can measure light from varied distances. Many eyes, on the contrary, are more or less elipsoidal; some with the long diameter from the cornea backwards, while many have the longest diameter from the nose to the temple, being actually flattened in the antero-posterior diameter. If in all such misshaped eyes, the crystalline lens be secured in the usual position, with the retina advanced or receded by the eye walls, sharp focusing must be materially disturbed, and vision necessarily made dull.

As an object is imaged on the retina, so the brain interprets it. If the image be a sharply outlined picture, the sight is called clear; if defectively focused, the mental impression must be one of fogginess. If the crystalline lens is either too far from or too near to the retina, the picture made by it, unfocused upon the sensitive recipient surface, must of necessity be a blurred one.

Near sighted long eyes, or over sighted flat eyes, are the common deviations of eyeballs from the standard shape. In the near sighted long eye, called *myopic*, the eye is so long in the antero-posterior diameter, that the lens is too far from the retina. The result is, that light passing from a distant object comes to a focus before it reaches the retina. As there is no surface to receive the image at the focal point of the crystalline lens, the light rays, not disturbed by the transparent vitreous, cross each other. They commence at once to scatter as they proceed backwards, till the retina finally stops their further progress. The moment the rays of light escape beyond the focal point, the image becomes blurred. The cloudiness of the picture increases in proportion to the distance the light travels before arrested. By this explanation, all near sighted persons, with their long eyes, and with the lens necessarily too far from the retina, must see distant objects as if in a fog, more or less dense, in proportion to the length of the eyeball.

There is no way that the eye itself can correct this defect of over length. The compressing band of elastic tissue, *the zonula of Zinn*, exerts its fullest flattening power when the ciliary muscle is at rest; and yet the focus is not long enough to reach the retina. Fortunately for the advancement of the human race, the physical science of optics teaches us, that by the combination of lenses of different configuration, convex or concave, we can lengthen or shorten the focus at will. When we place before a long eye a concave lens, it produces the same effect as if we flattened the crystalline lens. This converts it into a lens of weaker power, or longer focus, and allows it to form perfect pictures on the retina. This device of wearing proper concave spectacles will restore sharp sight for distant objects to such persons as have near sighted or long eyes. As the retina receives such pictures as the lens makes, and the brain must interpret such as are made, there can be no question of the propriety of having the retinal picture as sharply defined as possible, and of perfecting the outlining of the same by any physical means that science has devised. If children, either by inheritance or acquisition, have misshaped eyes, longer than the properly formed ones, so that they cannot see distant objects clearly, what can be the propriety of allowing them to go through life as if in a constant fog, when a properly selected glass clears up the mist and enables them to see as others do?

Reason and experience both unite in demanding for long near sighted eyes, whether in young or old persons, properly selected concave spectacles.

The second common deviation in the form of the human eye from the perfect standard is called *hyperopia*. It is a flat eye, with a short antero posterior diameter. This is a very common form of eye in children. A congenital defect, in which the crystalline lens is located so near the retina that light, passing into the eye, is stopped by the retina before it comes to a focus. This must also produce an unfocused, and, therefore, an imperfect, illy defined, picture. Fortunately, in such flat, hyperopic eyes, nature possesses a means of procuring relief, when distant objects are viewed, by causing the ciliary, eye-accommodating muscle to lift the compressing ligament. This allows the lens to increase the convexity of its surfaces, and shorten its focus to the desired extent for making the necessary sharply outlined retinal picture. This shortening of the focus necessitates a constant muscular effort, and consequently allows no rest for the eye muscles. Headache and eye pains must be the result from long continued and excessive muscular contraction in an eye constantly on the strain, for both distant and near work. With such children, the eyes can see clearly for a short period, then comes on pain accompanying the fatigue of the muscle, soon followed by muscular relaxation, with blurred, unfocused pictures. If we can add to the strength of the crystalline lens, by the addition of a magnifying spectacle, so as to secure a shorter focus, without calling upon the eye muscles to do this extra work, the eyes are put in the same condition as if they had been perfectly formed. All over-strain, to keep up sharply defined pictures, is now avoided. It is the innate desire to see clearly that induces some children to experiment with their parents' glasses. They make the accidental discovery of the means of relief which scientific examination would establish.

As children are often born with eyes either shorter or longer than the standard dimensions, we can readily understand how such defectively formed eyes must make imperfect images when the crystalline lens is placed out of focus, either too near to, or too far from the retina. Convex or concave spectacles, when carefully selected, both as to kind and strength, will correct the defect in focusing of the lens. They should be used on all children with faulty eyes. Unfortunately, such faulty eyes, which give out under use, do not appear differently from perfectly shaped ones. The flattening or the elongation is not in the exposed cornea. It is usually at the expense of the inner half of the eyeball, hid away in the socket. Trial glasses, or the optometer, a simple instrument for testing the range of the human eye, especially when aided by the instillation of a drop of an atropia solution in the eye, will exhibit the degree of the defect, and will determine the kind and strength of spectacle suited to any special case.